![dHybrid logo]

July 1st, 2015

dHybrid, Inc. EPA Manufacture Code: DHY
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Attn: Fakhri J. Hamady
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Dr.
Ann Arbor, MI 4810

Fakhri J. Hamady,

dHybrid a small vehicle manufacturer (SVM), EPA Manufacturer Code DHY would like to request an experimental vehicle testing exemption for the following vehicles to enable dHybrid to conduct emissions and durability tests on a mixed fuel of Diesel/Compressed Natural Gas (CNG) based on the 2002-2009 Detroit Diesel, diesel engines. The fuel system will be able to run on a mix of diesel and CNG as well as run on the original diesel with the original factory settings when natural gas is not available.

Projected Sales
dHybrid expects to sell an annual sales volume of approximately 50-100 systems of the dHybrid DD-1000 Dual Fuel system.

Proposed Modification
dHybrid is adding compressed natural gas (CNG) as a supplemental fuel delivery system to work in tandem with the factory diesel fuel system for the purpose of decreasing the emissions of these vehicles and to lower the cost of transportation fuel. The fuel is added by using a metering device that uses Bosch natural gas injectors. The natural gas is injected into the charged side of the air intake manifold, directly before the EGR inlet.

Test Program

Since dHybrid has received EPA experimental vehicle permits for the requested vehicles, it has then demonstrated through reliable testing that the dHybrid conversion system does not increase engine emissions output, and will provide the records documented from emissions and OBD testing to the EPA. In light of the EPA's recent discovery of possible extreme exhaust temperatures for some alternative fuel conversion systems, dHybrid will also ensure that the dHybrid fuel system when in use will monitor exhaust temperatures to ensure that under all engine speed and load conditions that the exhaust temperatures will approximate the OEM exhaust temperatures at the same load and engine speed points. Test results of exhaust temperatures under different engine speed and load conditions will be recorded and submitted from both the stock engine control and with the dHybrid engine control strategies to verify extreme exhaust temperatures are not being produced while the dHybrid fuel conversion system is in use. dHybrid is presenting this application data to submit its clean Alternative Fuels Conversion (AFC) demonstration information to EPA to prove that the dHybrid alternative fuel conversion system meets or exceeds any and all data submission requirements set forth by the EPA for the Heavy Duty Outside Useful Life (OUL) conversion systems.

- Vehicle A - with diesel fuel only

- Vehicle B - with clean alternative fuel conversion technologies

- *Vehicle A and Vehicle B will be the same test vehicle.*

Emissions Testing Equipment

This data is provided in the companion document generated by Sensors Inc. The file name of the test results document is: "dHYBRID Summary Report_ 040415 Rev B". This file has been submitted along with this document.

Testing company: Sensors Inc. (http:// http://www.sensors-inc.com/)

Sensors Inc. Testing Technician: Vio Filip

Time Period
dHybrid Inc. began over the road OUL compliance emissions testing with Sensors Inc. starting on 03/31/15 thru 04/03/15.

Operator and Location
A licensed driver that works for dHybrid was the operator of the test truck. The testing route is located just outside of Tampa, Florida near the Wesley Chapel/Brooksville, Florida area.

Vehicle Test Route Profile

This data is provided in the companion document generated by Sensors Inc. The file name of the test results document is: "dHYBRID Summary Report_ 040415 Rev B". This file has been submitted along with this document.

Test Results

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Facilities and Test Procedures

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Fuel Information		Conversion Manufacturer	Original Vehicle Information					Conversion Vehicle Information		
Conversion Fuel	Original Fuel		Model Year	OEM	OEM Test Group	OEM Evap Families	Eng Disp	Conversion Evap Family	Conversion Test Group	Conversion Models Covered
Diesel or Diesel/CNG or Diesel/LNG	Diesel	dHybrid Inc.	2002 to 2009	Detroit Diesel	2DDXH12.7EGL, 2DDXH14.0ELL, 3DDXH12.7EGY, 3DDXH14.0ELY, 4DDXH12.7EGY, 4MBXH12.8DJA, 4DDXH14.0ELY, 5DDXH12.7EGY, 5MBXH12.8DJA, 5DDXH14.0ELY, 6DDXH12.7EGY, 6MBXH12.8DJA, 6DDXH14.0ELY, 7DDXH12.8DJA, 7DDXH14.0ELY, 8DDXH12.8DJA, 8DDXH12.8DJC, 8DDXH14.0ELY, 8DDXH14.0ELC, 8DDXH12.8TER, 8DDXH14.8EEY, 8DDXH14.8EEC, 9DDXH12.8DJA, 9DDXH12.8FED, 9DDXH12.8TER, 9DDXH14.0ELY, 9DDXH14.8EEY, 9DDXH12.8DJD, 9DDXH12.8FEY, 9DDXH14.0ELD, 9DDXH14.8EED		12.7, 14, 12.8, 14.8	FDHYH14.0DD1		SERIES 60 , MBE 4000, OM460LA, NA, DD15, DD13

Test Engine Description:

2003 Detroit Diesel 12.7L Series 60 (3DDXH12.7EGY)

OEM Engine Families Seeking Approval:

2DDXH12.7EGL, 2DDXH14.0ELL, 3DDXH12.7EGY, 3DDXH14.0ELY, 4DDXH12.7EGY, 4DDXH14.0ELY, 5DDXH12.7EGY, 5DDXH14.0ELY, 6DDXH12.7EGY, 6DDXH14.0ELY, 7DDXH12.8DJA, 7DDXH14.0ELY, 8DDXH12.8DJA, 8DDXH12.8DJC, 8DDXH14.0ELY, 8DDXH14.0ELC, 8DDXH12.8TER, 8DDXH14.8EEY, 8DDXH14.8EEC, 9DDXH12.8DJA, 9DDXH12.8FED, 9DDXH12.8TER, 9DDXH14.0ELY, 9DDXH14.8EEY, 9DDXH12.8DJD, 9DDXH12.8FEY, 9DDXH14.0ELD, 9DDXH14.8EED

dHybrid Engine Conversion Family:

 FDHYH14.0DD1

Emissions Equipment Modifications:

Because these conversions are designed to revert back to the original factory settings and run on pure diesel when no CNG is available no emissions control components will be modified or removed. Once the dHybrid alternative fuel system conversion kit is installed a diesel oxidation catalyst will be installed to the after treatment system, as a passive emissions reduction component.
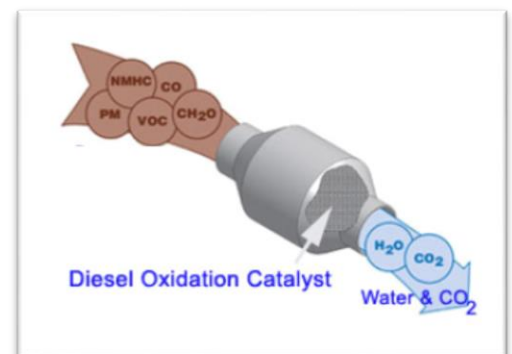
Equipment Descriptions:

The dHybrid designated emissions test group is targeted towards the 2002-2009 12.7L -14.8L Detroit Diesel, diesel engines. Which may be running with different over the road 6X4 chassis configurations. The dHybrid alternatively fueled, compressed natural gas fuel system consists of the following equipment, which is added to the existing Detroit Diesel engines.
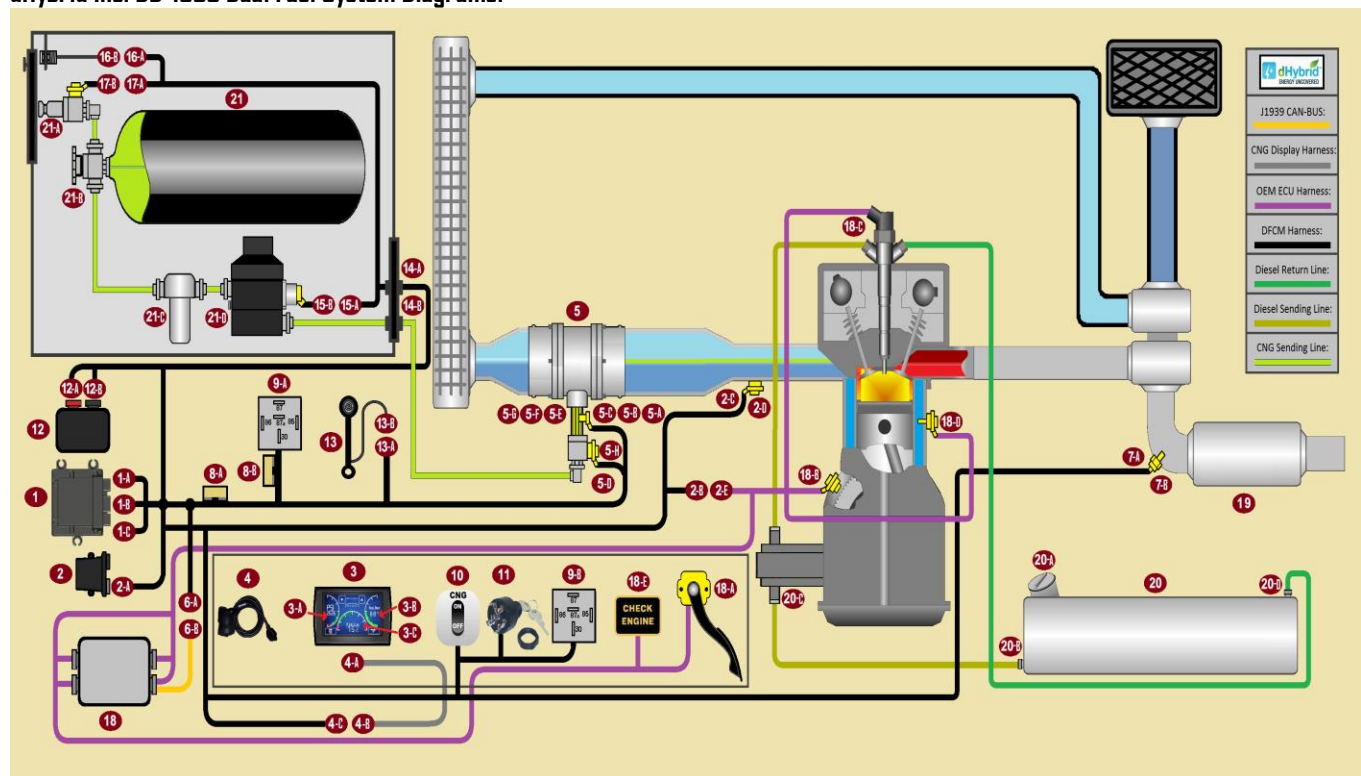
dHybrid Inc. DD-1000 Dual Fuel System Diagrams:

Figure #1 (dHybrid Inc. DD-1000 Dual Fuel System Diagrams – Detroit Diesel Engines - Without OEM Exhaust Aftertreatment System)
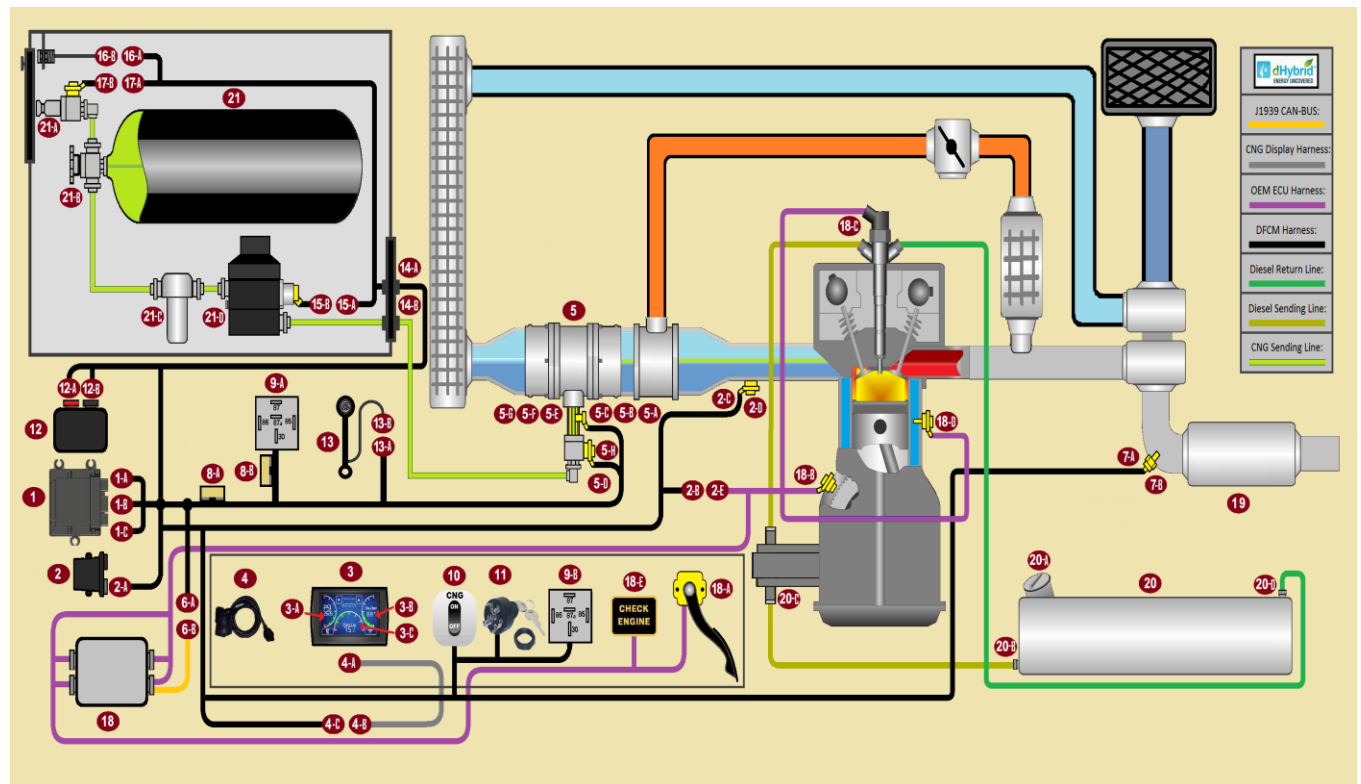

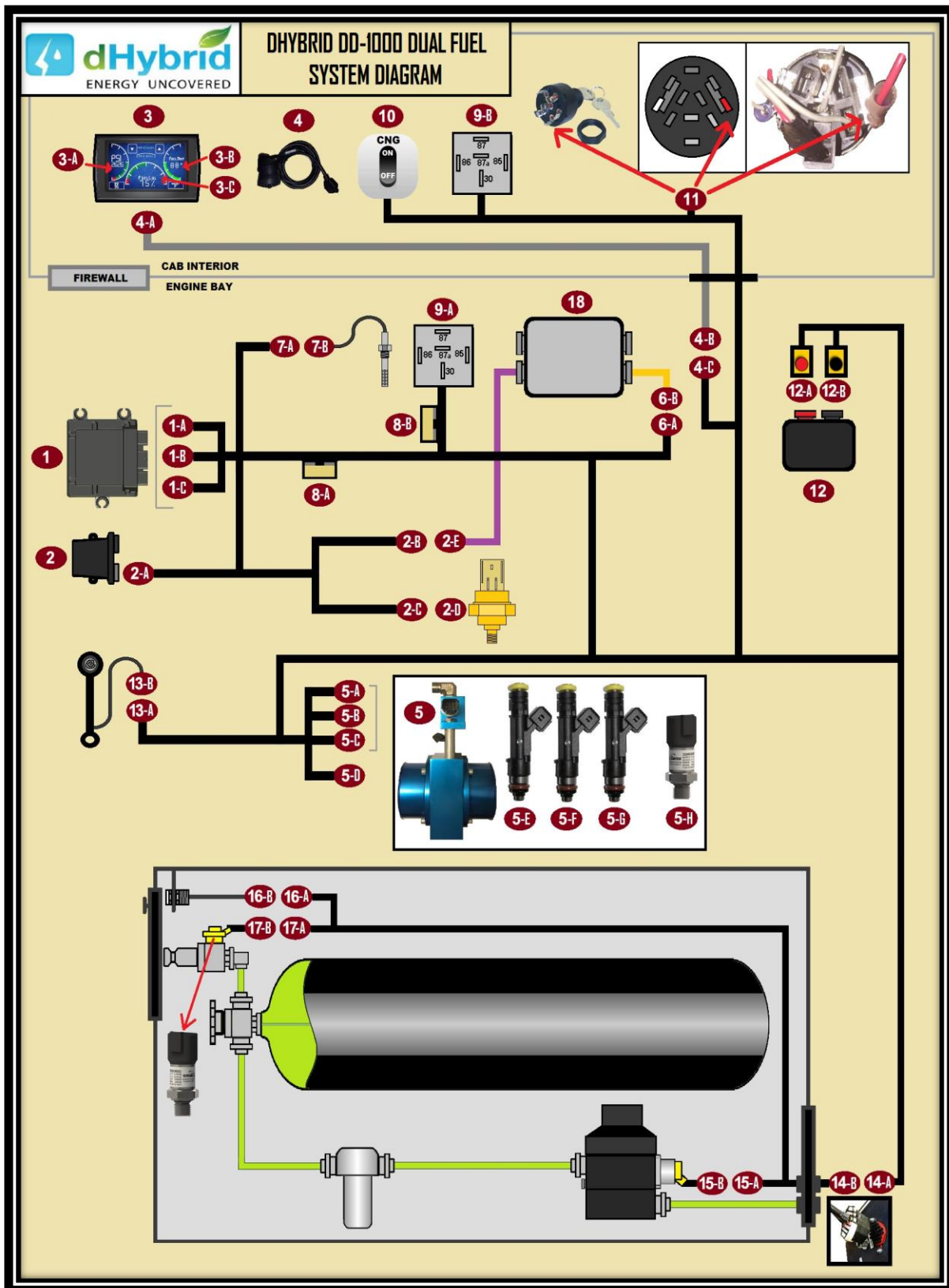**Figure #2 (dHybrid Inc. DD-1000 Dual Fuel System Diagrams – Detroit Diesel Engines - With EGR, and or DPF)**

dHybrid ENERGY UNCOVERED

DHYBRID DD-1000 DUAL FUEL SYSTEM DIAGRAM

FIREWALL | CAB INTERIOR
ENGINE BAY

CNG ON OFF

Figure #3: Overview of DD-1000 System Installation Diagram

Dhybrid ECU Type — **Engine Type Chassis Type**

ECU: 112-902904 | DDEC II-VI | Freightliner

#		Resource Name	ECU Pin Location	Amperage Rating & Recirc Diode / Resistor Type / Message Protocol / Wire Voltage	Current Sense / Polarity / Baud Rate	Application Note	Connector Location On DFCM Harness	Connector MFG Part #	Connector Pin Location	Wire Color
3	Outputs	Name	Location	Amperage Rating & Recirc Diode	Current Sense	Application Note	Connector Location On DFCM Harness	Connector MFG Part #	Connector Pin Location	Wire Color
4	Injector #1	FUEL-1	A-H1	2	N	Drive Bosch NGI2 CNG Injectors	5-E	Bosch Jettronic Female 2P:	B	Yellow
5	Injector #2	FUEL-2	A-H2	2	N	Drive Bosch NGI2 CNG Injectors	5-F	Bosch Jettronic Female 2P:	B	Blue
6	Injector #3	FUEL-3	A-G3	2	N	Drive Bosch NGI2 CNG Injectors	5-G	Bosch Jettronic Female 2P:	B	Pink
7	ITT CNG Pressure Regulator Lock-Off Valve	LSO1	A-F2	1	Y	ITT CNG Pressure Regulator Solenoid Valve (120PSI)	15-A	Tyco Superseal 1.5 Male 2P: 282080-1	B	Black
8	Starter Motor Output Signal	LSO6	A-E2	7	Y	Starter Motor Control Output	9-B	Ring Terminal Butt Crimp	N/A	White
9	DDEC Boost Sensor PWM 0-5VDC Signal	LSO10	A-E4	0.7	N	Duel Fuel SCM Boost Sensor PWM Signal	2-A	Deutsch Male 12P: ATM06-12SA	2	White
10	Duel Fuel SCM Safety PWM Signal	LSO2	A-E1	0.7	N	Duel Fuel SCM Safety PWM Signal	2-A	Deutsch Male 12P: ATM06-12SA	8	Brown
11	Inputs	Name	Location	Resistor Type	Polarity	Application Note	Connector Location On DFCM Harness	Connector MFG Part #	Connector Pin Location	Wire Color
12	CNG Fuel Door Proximity Sensor	AN2	B-F1	51k	PD	CNG Tank Fill Door Proximity Sensor Output Signal	16-A	Delphi Weather Pack Male 4P: 12015797	C	White
13	CNG Bumper Fill Sensor	AN11	C-B3	1k	PU	CNG CNG Bumper Fill Sensor Output Signal	13-A	Delphi Weather Pack Male 4P: 12015797	D	Green
14	EGT (Thermistor Type)	AN12	C-B4	1k	PU	Measure Exhaust Temp.	7-A	GT150 Female 2P:	B	Red
15	CNG Tank High Pressure Sensor	AN17	C-E2	220k	PD	Measure CNG Tank Pressure	17-A	Delphi Weather Pack Male 4P: 12015797	D	Green
16	CNG Tank Temp Sensor	AN22	C-E3	220k	PD	Measure CNG Tank Temp.	17-A	Delphi Weather Pack Male 4P: 12015797	C	White
17	CNG Fuel Rail Low Pressure Sensor	AN23	C-C4	220k	PD	Measure CNG Fuel Rail Pressure	5-H	Deutsch Male 4P: DT06-4S	C	Green
18	CNG Fuel Rail Temp Sensor	AN24	C-D1	220k	PD	Measure CNG Fuel Rail Temp.	5-H	Deutsch Male 4P: DT06-4S	4	White
19	DDEC Boost Sensor (OEM)	AN4	C-C3	220k	PD	DDEC Measure Boost Pressure	2-C	FCI/Delphi Apex 2.8 Female 3P: 54200309	A	Red
20	DDEC Boost SCM Feedback Signal	AN15	C-A3	220k	PD	DDEC Boost SCM Feedback Signal	2-B	FCI/Delphi Apex 2.8 Male 3P: 54200313	C	White
21	CAN/RS-485	Name	Location	Message Protocol	Baud Rate	Application Note	Connector Location On DFCM Harness	Connector MFG Part #	Connector Pin Location	Wire Color
22	CAN-1+	CAN1H	B-A1	J1939	250K-Baud	Duel Fuel ECU Calibration, Vehicle Shared Can Bus RX/TX	4-C	(J1939 HD-OBD) - Deutsch Male 9P: HD10-9-1939P-B022	C	White
23	CAN-1-	CAN1L	B-A2	J1939	250K-Baud	Duel Fuel ECU Calibration, Vehicle Shared Can Bus RX/TX	4-C	(J1939 HD-OBD) - Deutsch Male 9P: HD10-9-1939P-B023	D	Green
24	Misc	Name	Location	Wire Voltage	Polarity	Application Note	Connector Location On DFCM Harness	Connector MFG Part #	Connector Pin Location	Wire Color
25	Main Power Relay Driver	MPRD	A-D3	12-VDC	Negitive	Main Power Relay Driver: 12VDC - Output From DFCM	9-A	Delphi Weather Pack Male 4P: 12015797	B	Red
26	Key Switch Power	Key_Sw	B-G4	12-VDC	Negitive	Key on power switch input to wake DFCM and enable duel fueling.	11	Delphi Weather Pack Male 4P: 12015797	A	Red
27	Positive Voltage Input-Battery	BATT1	C-F4	12-VDC	Positive	Positive Voltage Input-Battery, +12VDC source to DFCM	12-A	Ring Terminal Butt Crimp	N/A	Red
28	Positive Voltage Input-Battery	BATT2	B-A3	12-VDC	Positive	Positive Voltage Input-Battery, +12VDC source to DFCM	12-A	Ring Terminal Butt Crimp	N/A	Red
29	Chassis Ground #1	GND-1	C-G1	12-VDC	Negitive	Chassis Ground #1: -12VDC source to DFCM	12-B	Delphi Weather Pack Male 4P: 12015797	B	Black
30	Chassis Ground #2	GND-2	C-G2	12-VDC	Negitive	Chassis Ground #2: -12VDC source to DFCM	12-B	Delphi Weather Pack Male 4P: 12015797	B	Black
31	Chassis Ground #3	GND-3	A-C4	12-VDC	Negitive	Chassis Ground #3: -12VDC source to DFCM	12-B	Delphi Weather Pack Male 4P: 12015797	B	Black
32	Driver Power #1	DRV/P-1	C-G3	12-VDC	Positive	Driver Power #1: +12VDC source to system injectors/actuators/SCM	9-A	Delphi Weather Pack Male 4P: 12015797	A	Red
33	Driver Power #2	DRV/P-2	C-H4	12-VDC	Positive	Driver Power #2: +12VDC source to system injectors/actuators/SCM	9-A	Delphi Weather Pack Male 4P: 12015797	A	Red
34	Transducer Power	XDRP-1	C-D4	5-VDC	Positive	Transducer power for CNG Fuel Rail and Tank Pressure/Temp Sensors	1-C	Ring Terminal Butt Crimp	N/A	Red
35	Transducer Ground #1	XDRG-1	B-D3	5-VDC	Negitive	Transducer ground for all DFCM Sensors	1-B	Ring Terminal Butt Crimp	N/A	Black
36	Transducer Ground #2	XDRG-2	A-D4	5-VDC	Negitive	Transducer ground for SCM Boost Sensor	1-A	Ring Terminal Butt Crimp	N/A	Black

Figure #4: DD-1000 System Electrical Harness Pinout Spreadsheet:

# DHYBRID DD-1000 DUALFUEL SYSTEM DIAGRAM - DEFINITIONS INDEX:

1: DFCM (DUAL FUEL CONTROL MODULE)
        1-A: DFCM HARNESS CONNECTOR - A
        1-B: DFCM HARNESS CONNECTOR - B
        1-C: DFCM HARNESS CONNECTOR - C

2: SCM (SIGNAL CONDITIONING MODULE)
        2-A: SCM HARNESS CONNECTOR TO MODULE
        2-B: SCM HARNESS CONNECTOR TO OEM ECM HARNEESS BOOST SENSOR INPUT
        2-C: SCM HARNESS CONNECTOR TO OEM BOOST SENSOR
        2-D: OEM BOOST SENSOR
        2-E: OEM ECM HARNESS BOOST SENSOR INPUT

3: CNG FUEL SYSTEM DISPLAY
        3-A: CNG TANK FUEL PRESSURE – PSI VALUE
        3-A: CNG TANK FUEL TEMPERATURE - DEGREES FAHRENHEIT VALUE
        3-A: CNG TANK FUEL LEVEL - PERCENT FULL VALUE

4: CNG FUEL SYSTEM DISPLAY HARNESS
        4-A: CNG FUEL SYSTEM DISPLAY HARNESS CONNECTION TO DISPLAY
        4-B: CNG FUEL SYSTEM DISPLAY HARNESS CONNECTION TO DFCM HARNESS
        4-C: DFCM HARNESS CONNECTION TO CNG FUEL SYSTEM DISPLAY

5: CNG FMV (FUEL METERING VALVE)
        5-A: CNG FUEL INJECTOR #1 – DFCM HARNESS CONNECTOR
        5-B: CNG FUEL INJECTOR #2 – DFCM HARNESS CONNECTOR
        5-C: CNG FUEL INJECTOR #3 – DFCM HARNESS CONNECTOR
        5-D: CNG FUEL RAIL PRESSURE/TEMPERATURE SENSOR – DFCM HARNESS CONNECTOR
        5-E: CNG FUEL INJECTOR #1
        5-F: CNG FUEL INJECTOR #2
        5-G: CNG FUEL INJECTOR #3
        5-H: CNG FUEL RAIL PRESSURE/TEMPERATURE SENSOR

6: J1939 VEHICLE CAN BUS NETWORK
        6-A: J1939 VEHICLE CAN BUS NETWORK CONNECTION TO DHYBRID DFCM
        6-B: J1939 VEHICLE CAN BUS NETWORK CONNECTION TO OEM ECM

7: EGT (EXHAUST GAS TEMPERATURE) MEASUREMENT
        7-A: EGT SENSOR - DFCM HARNESS CONNECTOR
        7-B: EGT SENSOR

8: DFCM SYSTEM FUSES
        8-A: MAIN POWER INPUT FUSE – 25 AMP
        8-B: ACTUATOR POWER OUTPUT FUSE – 25 AMP

9: DFCM SYSTEM RELAYS
        9-A: MAIN POWER REALY
        9-B: STARTER INTERRUPT RELAY

10: DFCM SYSTEM SHUTOFF SWITCH

11: DFCM SYSTEM CONNECTION TO VEHICLE IGNITION SIGNAL

12: VEHICLE 12VDC BATTERY
        12A: DFCM SYSTEM CONNECTION TO VEHICLE 12VDC BATTERY POWER **+**
        12B: DFCM SYSTEM CONNECTION TO VEHICLE 12VDC BATTERY POWER **–**

13: CNG FRONT BUMPER FUELING DETECTION MEASUREMENT
        13-A: CNG FRONT BUMPER FUELING DETETECTION SENSOR - DFCM HARNESS CONNECTOR
        13-B: CNG FRONT BUMPER FUELING DETETECTION SENSOR

14: CNG FUEL STORAGE/SUPPLY SYSTEM BULKHEAD HARNESS JUNCTION

14-A: CNG FUEL STORAGE/SUPPLY SYSTEM HARNESS JUNCTION - DFCM HARNESS CONNECTOR

14-B: CNG FUEL STORAGE/SUPPLY SYSTEM HARNESS JUNCTION - ENCLOSURE BULKHEAD CONNECTOR

15: CNG FUEL SUPPLY SYSTEM PRESSURE REGULATOR FUEL LOCK OFF SOLENOID VALVE

15-A: CNG FUEL RAIL PRESSURE REGULATOR - SOLENOID VALVE HARNESS CONNECTOR

15-B: CNG FUEL RAIL PRESSURE REGULATOR - SOLENOID VALVE

16: CNG FUEL STORAGE/SUPPLY SYSTEM ENCLOSURE DOOR PROXIMITY MEASUREMENT

16-A: ENCLOSURE DOOR PROXIMITY SENSOR- HARNESS CONNECTOR

16-B: ENCLOSURE DOOR PROXIMITY SENSOR

17: CNG FUEL TANK STORAGE PRESSURE/TEMPERATURE MEASUREMENT

17-A: CNG FUEL TANK STORAGE PRESSURE/TEMPERATURE SENSOR - HARNESS CONNECTOR

17-B: CNG FUEL TANK STORAGE PRESSURE/TEMPERATURE SENSOR

18: OEM - DETROIT DIESEL ECM (ENGINE CONTROL MODULE)

18-A: OEM DDEC ACCELERATOR PEDAL SENSOR/DRIVERS DEMANDED TORQUE REQUEST

18-B: OEM DDEC ENGINE SPEED SENSOR

18-C: OEM DDEC DIESEL FUEL METERING INJECTORS

18-D: OEM DDEC ENGINE COOLANT TEMPRATURES SENSOR

18-E: OEM DDEC CHECK ENGINE LIGHT

19: ENGINE AFTERTREATMENT SYSTEM

20: DIESEL FUEL SUPPLY/STORAGE SYSTEM – DIESEL TANK

20-A: DIESEL TANK FILL RECEPTACLE

20-B: DIESEL FUEL SENDING LINE TO ENGINE

20-C: DIESEL FUEL PUMP

20-D: DIESEL FUEL RETURN LINE FROM ENGINE

21: CNG FUEL STORAGE/SUPPLY SYSTEM- CNG TANK

21-A: CNG TANK FILL RECEPTACLE

21-B: CNG TANK MANUAL LOCK OFF VALVE

21-C: CNG HIGH PRESSURE FILTER

21-D: CNG PRESSURE REDUCER/REGULATOR

dHybrid DD-1000 System Outside Useful Life Compliance Labeling

Dhybrid Inc. DD-1000 Dual Fuel System Warranty

1: DFCM (DUAL FUEL CONTROL MODULE)
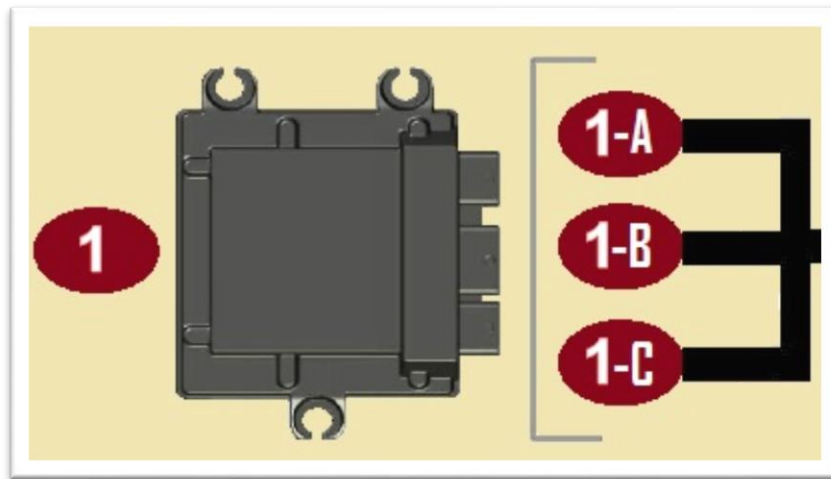
Part Manufacturer: Woodward Governor
Manufacturer Part #: ECM-5554-112-0904

dHybrid proprietary DFCM – This is a supplemental embedded controller that interfaces with the factory controller to transmit and receive data via the J1939 CAN vehicle network. The exchanged J1939 data allows for the dHybrid proprietary dual fueling algorithm to accurately determine the amount of CNG the natural gas injectors need to deliver to the engine as means to substitute the amount of diesel fuel that is trimmed by the OEM ECU via a TSC1 torque limiting request from the DFCM. This highly sophisticated fueling algorithm has been designed and tested to achieve an accurately controlled dual fuel combustion. This high level of control over the engines total fueling, across the drivers demanded torque request map, allows for a direct fuel swap during all driving conditions. The DFCM limits the total amount of diesel that is injected into the engine by broadcasting a J1939 CAN message that is called TSC1 (Torque/Speed Control 1). The specific message that is used is the torque limiting message, which has an update rate of 10 milliseconds. When the OEM ECU receives the TSC1 torque limiting value and reduces the total amount of injected diesel, the DFCM then substitutes with an equivalent amount of CNG to be injected into the boosted air intake. In order to determine what the total fuel substitution will be at any given engine load and speed point, there are many different sensor values that are referenced to ensure proper fuel combustion. The DFCM also controls the total amount of airflow to the combustion chamber by sending a signal to the SCM, which allows for proper air fuel ratios during dual fueling mode. To display any fault codes that are active on the DFCM, a J1939 message with Dhybrid proprietary diagnostic trouble codes (DTC) is sent to the DD-1000 system display in the cab. This allows shop techs that work on the system to properly service and repair the system. The DFCM also sends relevant fuel system sensor values to be displayed on the in cab display. The DFCM is attached to a mounting plate that when installed on an engine is bolted to the Detroit Diesel engine above the engines intake manifold.
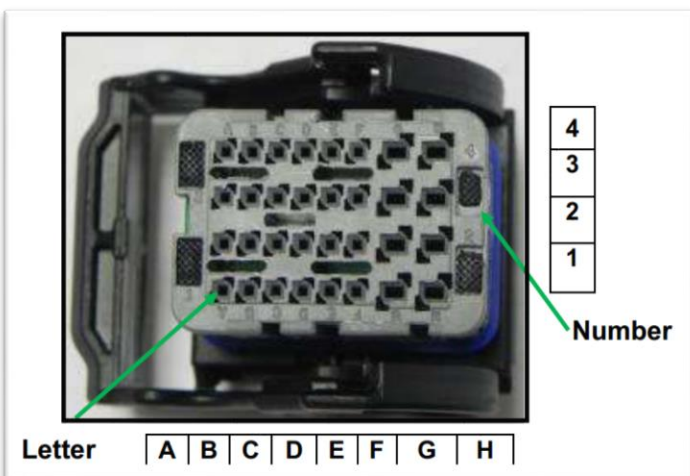
1-A: DFCM HARNESS CONNECTOR – A
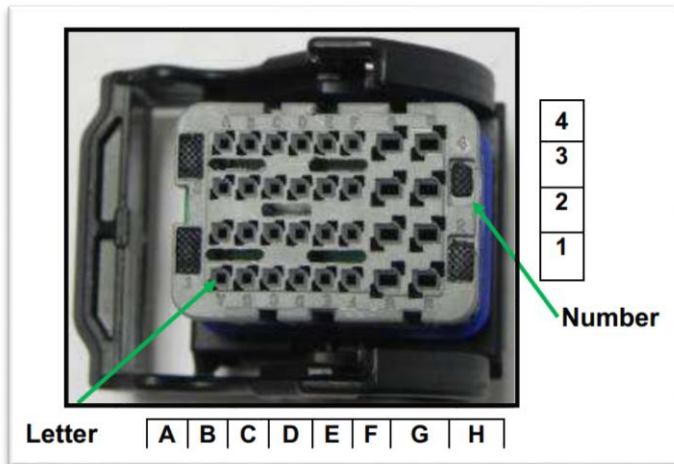
PART MANUFACTURER: Molex
MANUFACTURER PART #: 98944-2001-32
CONNECTOR PINOUT: See Figure #4
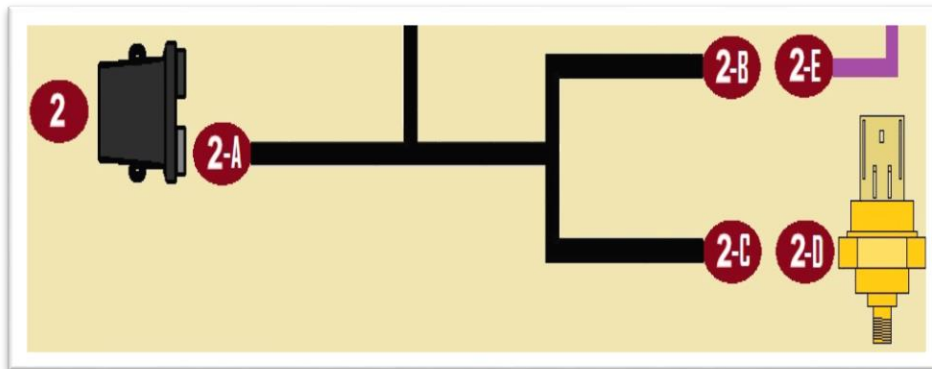
1-B: DFCM HARNESS CONNECTOR – B
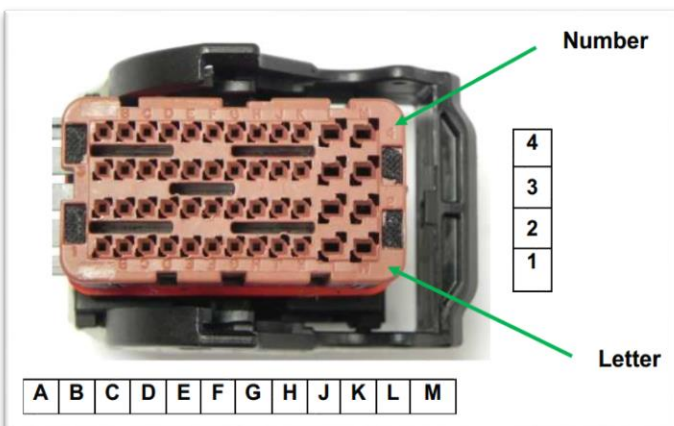
PART MANUFACTURER: Molex
MANUFACTURER PART #: 98950-2003-48
CONNECTOR PINOUT: See Figure #4
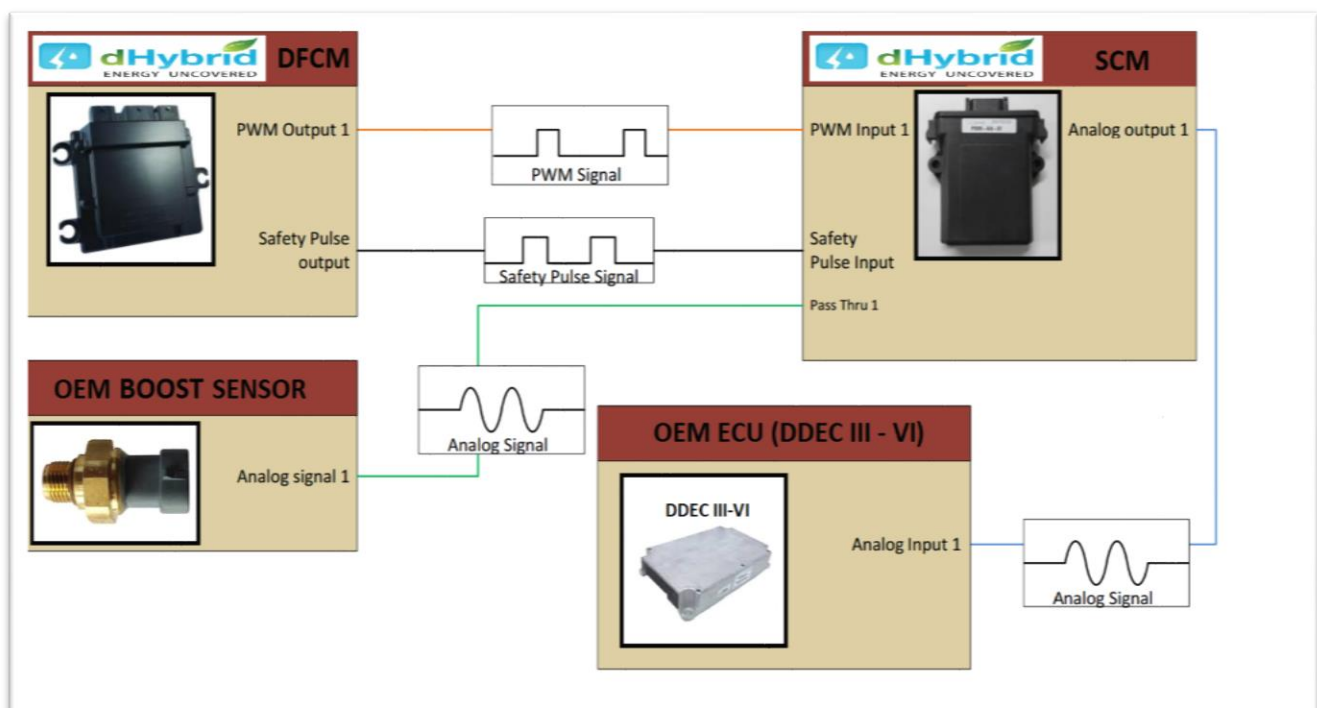
1-C: DFCM HARNESS CONNECTOR – C

PART MANUFACTURER: Molex
MANUFACTURER PART #: 98944-3002-32
CONNECTOR PINOUT: See Figure #4

2: SCM (SIGNAL CONDITIONING MODULE)

PART MANUFACTURER: Neweagle
MANUFACTURER PART #: PWM-AN-012-1301

dHybrid proprietary signal conditioning module (SCM) –In order for the DD-1000 system to provide proper air fuel mixtures in the combustion chamber of the engine it is installed on, and to allow for increased flow of boosted air into the engine during Dual Fueling mode the Dhybrid Inc. DD-1000 system uses a device called the "Signal Conditioning Module" (SCM). This module uses an internal normally closed relay circuit to allow the OEM Boost sensor signal to be read as it originally was designed to do by the OEM. When the engine is operating in Dual Fueling mode the SCM's internal relay switches and passes a new analog voltage value to simulate the OEM boost sensor signal. The SCM requires a safety pulse to be sent from the DFCM to enable its boost signal conditioning to manipulate the analog voltage value. This prevents the SCM from controlling the OEM boost sensor signal voltage if the DFCM were to suffer from any type of failure mode. The DFCM as previously described, uses a J1939 CAN-BUS TSC1 message to control total diesel fueling at any given engine speed and load point. This TSC1 message controls total toque limiting. When the OEM ECU receives this message it limits torque by reducing the total amount of diesel fuel that is injected into the engine. The OEM ECU also limits the total mass air charge based on how much diesel fuel it commands to be injected. This created limitations for proper air fuel ratios, and as a consequence limited total available engine toque to be met when in duel fueling mode. This is why an SCM was added to the DD-1000 Dual Fuel system. The amount of boost signal voltage modification that the DFCM commands the SCM to produce is based on the total TSC1 torque limit percent value that the DFCM is sending to the OEM ECU. When the OEM ECU receives the modified boost sensor

voltage, its logic then modifies the vane position of the variable nozzle turbocharger to increase the total boosted airflow. The SCM allows the DFCM to manipulate the mass air charge flow during dual fuel mode, by intercepting and manipulating the boost pressure sensor signal voltage to the OEM ECU. When the dHybrid alternative fuel system is manually disabled by the driver or if the dHybrid fueling logic is not set to dual fuel mode, then the SCM will allow the original unmodified boost pressure sensor signal to be received by the OEM ECU. The boost sensor signal voltage is measured by the dHybrid ECU during dual fuel mode and sends a PWM signal to the dHybrid SCM that is converted to an analog 0-5VDC signal, the same type of signal that the OEM ECU is designed to receive. This allows the dHybrid ECU to dynamically control the amount of airflow through the engine during dual fuel mode that then allows the dHybrid system to better achieve desired emissions output during dual fuel mode by optimizing the air to fuel ratios in different parts of the engines fueling map. The SCM comes mounted to the DFCM on an engine mounting plate which is bolted to the Detroit Diesel engine above the engines intake manifold.

2-A: SCM HARNESS CONNECTOR TO MODULE

PART MANUFACTURER: Deutsch (Tyco)
MANUFACTURER PART #:
CONNECTOR PINOUT:
      1: DRVP (12VDC+)
      2: DFCM to SCM - Boost Control Signal (PWM)
      3: N/A
      4: N/A
      5: OEM ECU Boost Signal (Pass through mode only)
      6: N/A
      7: N/A
      8: N/A
      9: N/A
      10: N/A
      11: SCM to OEM ECU Boost Signal (0-5VDC +)
      12: Chassis Ground (12VDC -)

2-B: SCM HARNESS CONNECTOR TO OEM ECM HARNEESS BOOST SENSOR INPUT

PART MANUFACTURER: FCI (Delphi)
MANUFACTURER PART #: 54200313
CONNECTOR PINOUT:
      A: OEM ECU Sensor Ground (5VDC -)
      B: OEM ECU Boost Sensor Signal (SCM Controlled)
      C: OEM ECU Sensor Power (5VDC +)

This connector mates with the Detroit Diesel OEM harness boost sensor input connector, so that the SCM simulated boost signal can be seen by the OEM ECU.

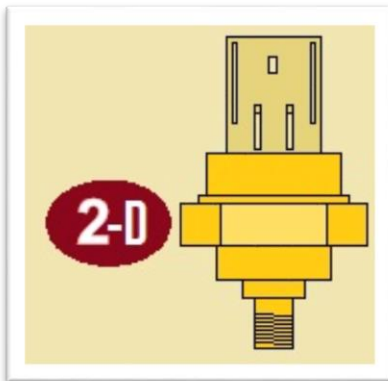### 2-C: SCM HARNESS CONNECTOR TO OEM BOOST SENSOR

PART MANUFACTURER: FCI (Delphi)
MANUFACTURER PART #: 54200309
CONNECTOR PINOUT:
        A: OEM ECU Sensor Ground (5VDC -)
        B: OEM ECU Boost Sensor Signal
        C: OEM ECU Sensor Power (5VDC +)

This connector mates with the Detroit Diesel OEM boost sensor, so that the DFCM and SCM can measure actual boost pressure.

2-D: OEM BOOST SENSOR

PART MANUFACTURER: Detroit Diesel
MANUFACTURER PART #: 23527829
CONNECTOR PINOUT:
        A: OEM ECU Sensor Ground (5VDC -)
        B: OEM ECU Boost Sensor Signal
        C: OEM ECU Sensor Power (5VDC +)

Detroit Diesel Boost Pressure Sensor: Parameter engineering units – kPa. This is referenced in order to map the air charge that will be adjusted by the Dhybrid SCM.

2-E: OEM ECM HARNESS BOOST SENSOR INPUT

PART MANUFACTURER: FCI (Delphi)
MANUFACTURER PART #: 54200309
CONNECTOR PINOUT:
        A: OEM ECU Sensor Ground (5VDC -)
        B: OEM ECU Boost Sensor Signal (From SCM)
        C: OEM ECU Sensor Power (5VDC +)

3: CNG FUEL SYSTEM DISPLAY
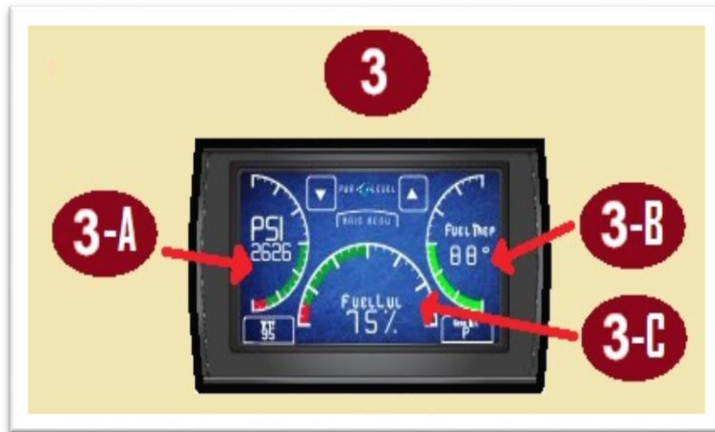
PART MANUFACTURER: Powerteq/Edge Products
MANUFACTURER PART #: X00007400

3-A: CNG TANK FUEL PRESSURE – PSI VALUE

3-A: CNG TANK FUEL TEMPERATURE - DEGREES FAHRENHEIT VALUE

3-A: CNG TANK FUEL LEVEL - PERCENT FULL VALUE

CNG Fuel System Display– This is a display device that is located on the dash of the cab that receives input from the pressure and temperature sensors on the fuel tanks to allow the driver to know the fuel level of the CNG system. This display also monitors fault codes and other parameters on the J1939 network, thus enabling vehicle drivers or shop technicians to quickly diagnose problems when they arise.

dHybrid proprietary DTCs:
SPN id: 520192 = 12VDC ECUP Circuit Fault
SPN id: 520193 = 12VDC DRVP Circuit Fault
SPN id: 520194 = 5VDC XDRPA Circuit Fault
SPN id: 520195 = 5VDC XDRPB Circuit Fault
SPN id: 520196 = EGT1 Sensor Fault
SPN id: 520197 = NGP Tank Pressure Sensor Fault
SPN id: 520198 = NGP Tank Temperature Sensor Fault
SPN id: 520199 = NGP Fuel Rail Pressure Sensor Fault
SPN id: 520200 = NGP Fuel Rail Temperature Sensor Fault
SPN id: 520202 = OEM Boost Sensor Fault
SPN id: 520203 = SCM Boost Feedback Circuit Fault
SPN id: 520204 = Bumper Fill Sensor Fault
SPN id: 520205 = Fuel Door Proximity Sensor Fault
SPN id: 520207 = Main Power Relay Circuit Fault
SPN id: 520208 = Starter Lockout Fault
SPN id: 520209 = Lock-Off Control Valve Fault
SPN id: 520210 = Fuel Injector 1 Fault
SPN id: 520211 = Fuel Injector 2 Fault
SPN id: 520212 = Fuel Injector 3 Fault
SPN id: 520218 = SCM Component Fault
SPN id: 520219 = System Level Fault

4: CNG FUEL SYSTEM DISPLAY HARNESS

PART MANUFACTURER: Powerteq/Edge Products
MANUFACTURER PART #: H00006800

4-A: CNG FUEL SYSTEM DISPLAY HARNESS CONNECTION TO DISPLAY
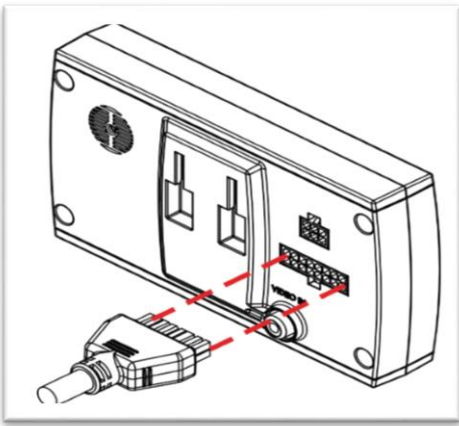
4-B: CNG FUEL SYSTEM DISPLAY HARNESS CONNECTION TO DFCM HARNESS

PART MANUFACTURER: Deutsch (Tyco)
MANUFACTURER PART #:
CONNECTOR PINOUT:
       A: 12VDC -
       B: 12VDC +
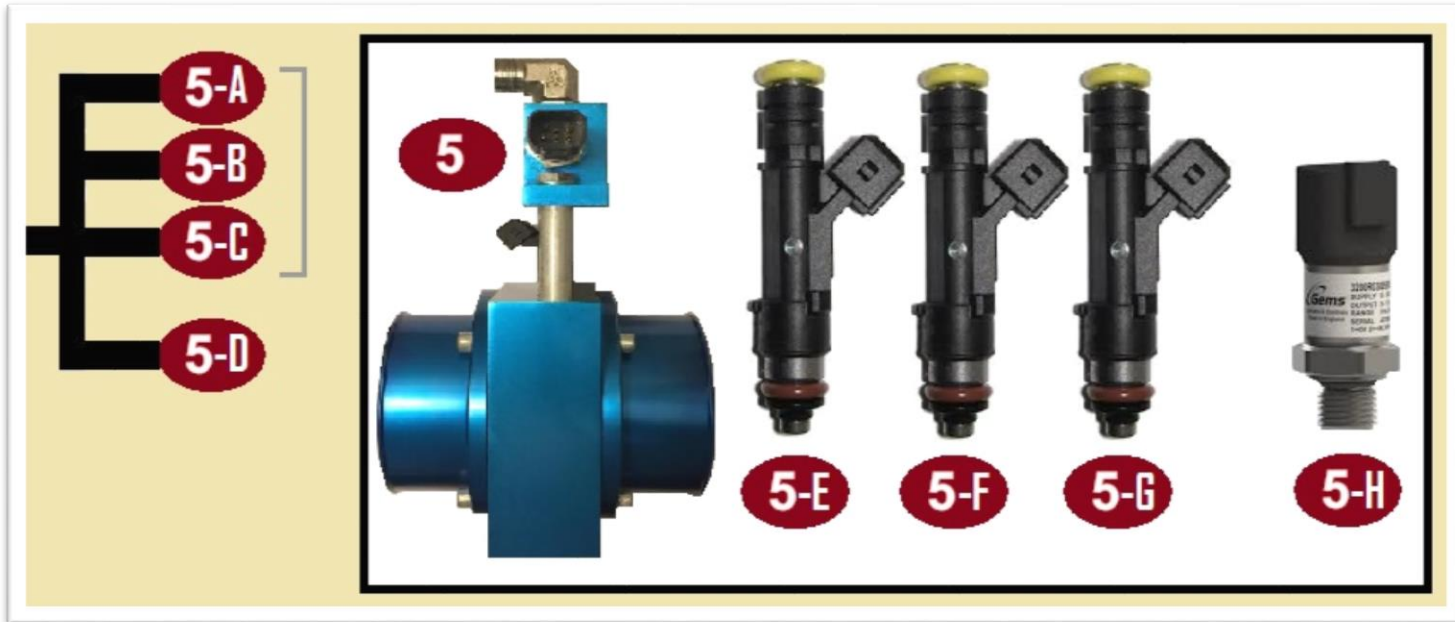   C: J1939 CAN BUS- High
       D: J1939 CAN BUS- Low
       E: N/A
       F: N/A
       G: N/A
       H: N/A
       J: N/A

4-C: DFCM HARNESS CONNECTION TO CNG FUEL SYSTEM DISPLAY

PART MANUFACTURER: Deutsch (Tyco)
MANUFACTURER PART #:
CONNECTOR PINOUT:
      A: 12VDC -
      B: 12VDC +
      C: J1939 CAN BUS- High
      D: J1939 CAN BUS- Low
      E: N/A
      F: N/A
      G: N/A
      H: N/A
      J: N/A

5: CNG FMV (FUEL METERING VALVE)

The FMV is composed of two main parts and are described below:

1. **CNG injector pack –** This is a CNG metering device that uses 3 Bosch CNG injectors that inject natural gas into CNG/Charged air infuser. The injector pack uses a CNG temperature and pressure sensor, which are used in tandem with the ideal gas law in calculating how long each injector needs to remain open in order to allow an exact amount of gas to be injected.

2. **CNG/Charged air infuser –** This is a device, which is attached to the CNG injector pack. It is mounted after the intercooler and before the EGR inlet, which allows natural gas that is metered from the injectors to then enter and blend into the charged air within intake manifold.

5-A: CNG FUEL INJECTOR #1 – DFCM HARNESS CONNECTOR

PART MANUFACTURER: Delphi
MANUFACTURER PART #: 12129142
CONNECTOR PINOUT:
      A: DRVP – 12VDC +
      B: Injector #1 PWM Signal

5-B: CNG FUEL INJECTOR #2 – DFCM HARNESS CONNECTOR

PART MANUFACTURER: Delphi
MANUFACTURER PART #: 12129142
CONNECTOR PINOUT:
      A: DRVP – 12VDC +
      B: Injector #2 PWM Signal

5-C: CNG FUEL INJECTOR #3 – DFCM HARNESS CONNECTOR

PART MANUFACTURER: Delphi
MANUFACTURER PART #: 12129142
CONNECTOR PINOUT:
      A: DRVP (12VDC +)
      B: Injector #3 PWM Signal

5-D: CNG FUEL RAIL PRESSURE/TEMPERATURE SENSOR – DFCM HARNESS CONNECTOR
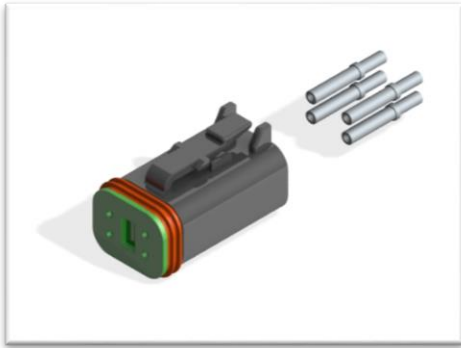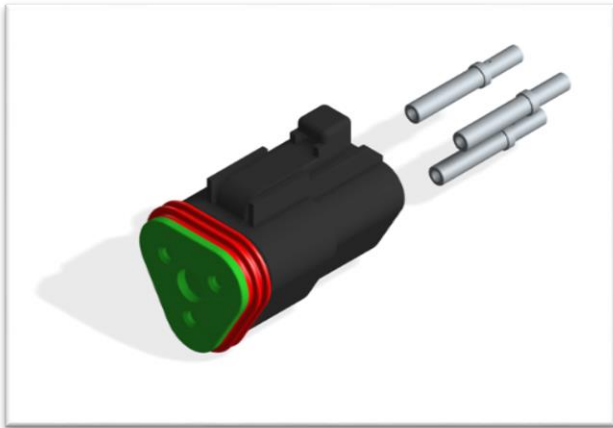
PART MANUFACTURER: Deutsch (Tyco)
MANUFACTURER PART #:
CONNECTOR PINOUT:
      1: XDRG (5VDC -)
      2: XDRP (5VDC+)
      3: Fuel Rail Temp. Signal
      4: Fuel Rail Press. Signal

In order for the DFCM to measure the CNG density of the CNG going to the FMV this connector has to be connected to the FMV CNG pressure/temperature sensor.

5-E: CNG FUEL INJECTOR #1

PART MANUFACTURER: Bosch
MANUFACTURER PART #: 0280158827
CONNECTOR PINOUT:
      A: DRVP (12VDC +)
      B: Injector #1 PWM Signal

Each Bosch CNG injector has the ability to flow up to 10 KG/Hour of CNG and the total flow rate is dynamically, based on how long it is actuated in the open position by the DFCM.

5-F: CNG FUEL INJECTOR #2

PART MANUFACTURER: Bosch
MANUFACTURER PART #: 0280158827
CONNECTOR PINOUT:
      A: DRVP (12VDC +)
      B: Injector #2 PWM Signal

Each Bosch CNG injector has the ability to flow up to 10 KG/Hour of CNG and the total flow rate is dynamically, based on how long it is actuated in the open position by the DFCM.

5-G: CNG FUEL INJECTOR #3

PART MANUFACTURER: Bosch
MANUFACTURER PART #: 0280158827
CONNECTOR PINOUT:
      A: DRVP (12VDC +)
      B: Injector #3 PWM Signal

Each Bosch CNG injector has the ability to flow up to 10 KG/Hour of CNG and the total flow rate is dynamically, based on how long it is actuated in the open position by the DFCM.

5-H: CNG FUEL RAIL PRESSURE/TEMPERATURE SENSOR

PART MANUFACTURER: GEMS
MANUFACTURER PART #: 3101T200PG1P8000
CONNECTOR PINOUT:
      1: XDRG (5VDC -)
      2: XDRP (5VDC+)
      3: Fuel Rail Temp. Signal
      4: Fuel Rail Press. Signal

The FMV CNG fuel rail pressure/temperature sensor allows the DFCM to calculate the CNG density and is then able to determine how long to open or close the CNG injectors in order to meter an accurate amount of CNG to flow into the combustion chamber to provide the correct amount of power to substitute the amount of diesel that was trimmed by the DFCM TSC1 torque limit command that is sent to the Detroit Diesel ECU.

6: J1939 VEHICLE CAN BUS NETWORK
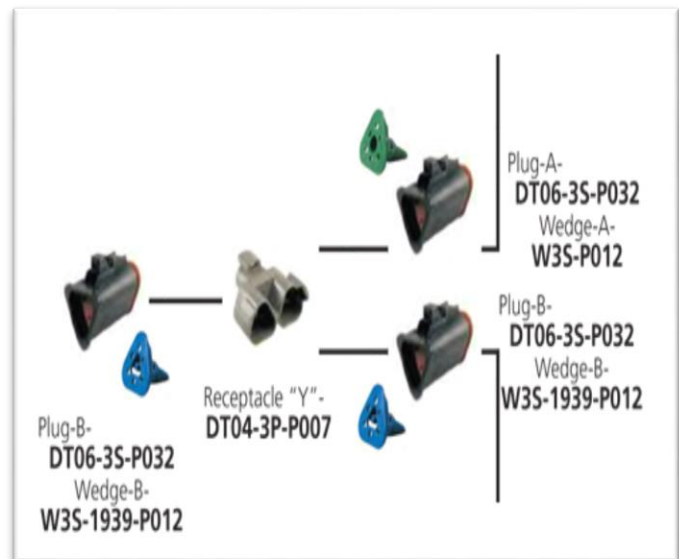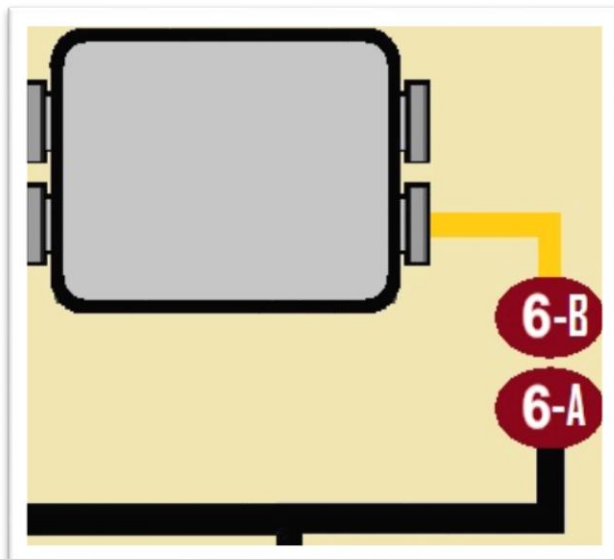
6-A: J1939 VEHICLE CAN BUS NETWORK CONNECTION TO DHYBRID DFCM

PART MANUFACTURER: Deutsch (Tyco)
MANUFACTURER PART #: DT06-3S
CONNECTOR PINOUT:
        A: J1939 CAN BUS-High
        B: J1939 CAN BUS-Low
        C: N/A

6-B: J1939 VEHICLE CAN BUS NETWORK CONNECTION TO OEM ECM
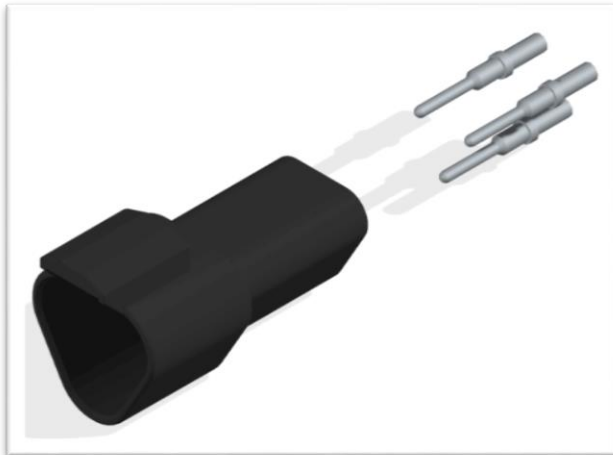
PART MANUFACTURER: Deutsch (Tyco)
MANUFACTURER PART #: DT04-3P
CONNECTOR PINOUT:
        A: J1939 CAN BUS-High
        B: J1939 CAN BUS-Low
        C: N/A

7: EGT (EXHAUST GAS TEMPERATURE) MEASUREMENT
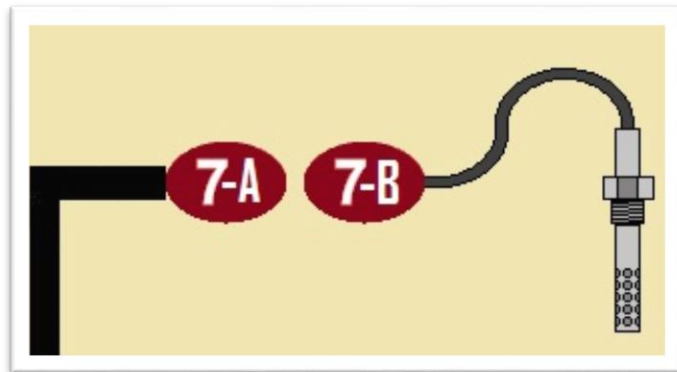
Exhaust Gas Sensors – All vehicle applications that do not have existing exhaust gas temperature sensors in which a dHybrid system is installed on, will be equipped with an exhaust temperature sensor to ensure prevention of extreme exhaust temperatures while the dHybrid fuel conversion system is in use. The EGT sensor is installed post turbo charger and pre DOC.

7-A: EGT SENSOR - DFCM HARNESS CONNECTOR

PART MANUFACTURER: Delphi
MANUFACTURER PART #: 13510099
CONNECTOR PINOUT:
        A: XDRG (5VDC -)
        B: EGT Sensor Signal

7-B: EGT SENSOR
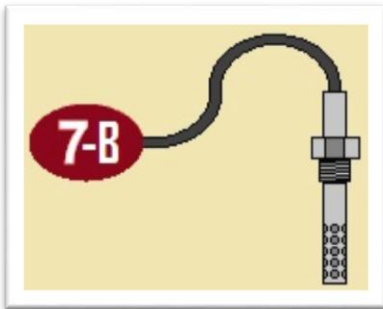
PART MANUFACTURER: Sensata
MANUFACTURER PART #: TS200-F
CONNECTOR PINOUT:
        A: XDRG (5VDC -)
        B: EGT Sensor Signal

8: DFCM SYSTEM FUSES
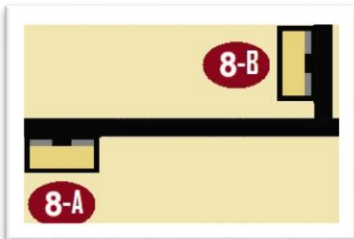
The DD-1000 uses 2 different 25 Amp fuses to ensure that if there is a system electrical short that the electrical components are not damaged.

8-A: MAIN POWER INPUT FUSE – 25 AMP
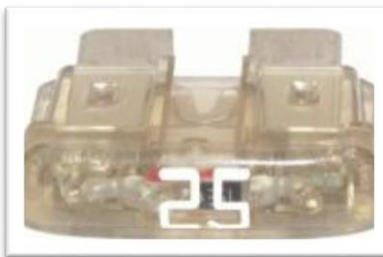
PART MANUFACTURER: Littlefuse
MANUFACTURER PART #: 0287025

This 25 Amp fuse is used to prevent the DFCM's internal circuitry from being damaged in the event of an electrical short.

8-B: ACTUATOR POWER OUTPUT FUSE – 25 AMP

PART MANUFACTURER: Littlefuse
MANUFACTURER PART #: 0287025

This 25 Amp fuse is used to prevent the DD-1000 system actuators/injectors circuitry from being damaged in the event of an electrical short.

9: DFCM SYSTEM RELAYS
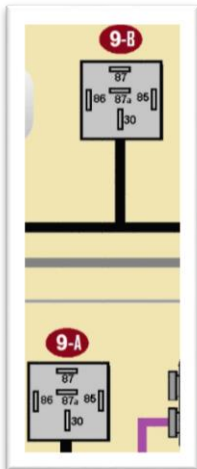
9-A: MAIN POWER REALY

PART MANUFACTURER: Pico
MANUFACTURER PART #: 928-91

This is a normally open 30 Amp 12VDC weatherproof sealed relay. The function of this relay is controlled by the DFCM and is used to enable and disable current flow to any of the DD-1000 system fueling actuators/injectors.

9-B: STARTER INTERRUPT RELAY

PART MANUFACTURER: Pico
MANUFACTURER PART #: 928-91

This is a normally closed 30 Amp 12VDC weatherproof sealed relay. The function of this relay is controlled by the DFCM and is used to prevent starting of the engine if the CNG fueling receptacles are being used to fill the CNG tanks. This is to prevent the driver from driving away from a CNG station if the fill hose is still attached to the CNG fueling receptacles.

10: DFCM SYSTEM SHUTOFF SWITCH

PART MANUFACTURER: Pico
MANUFACTURER PART #: 5541A

The switch is used in case of an emergency if the driver detects a CNG leak on the system and when placed into the off position will disable the DD-1000 system and will prevent any CNG from escaping the CNG pressure reducer/regulator. To enable dual fueling mode, this switch must be in the on positon. This switch passes a 12VDC signal to the DFCM and if the DFCM does not see this signal, then it will disable dual fuel mode.

11: DFCM SYSTEM CONNECTION TO VEHICLE IGNITION SIGNAL
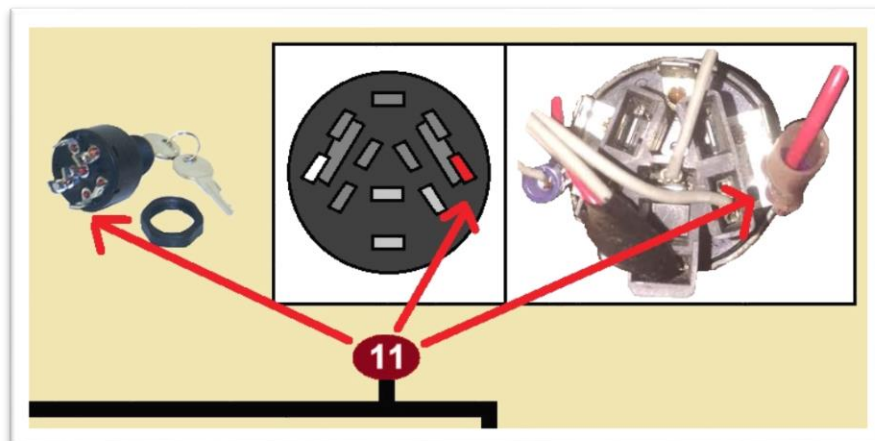
The DFCM requires a 12VDC signal to enable dual fueling, and so the source used for this 12VDC signal is the vehicles key switch – "Run/ACC" position output 12VDC signal.

12: VEHICLE 12VDC BATTERY

The DD-1000 sources its system 12VDC power directly from the vehicle batteries, in order to drive all of the systems electronic components.

12A: DFCM SYSTEM CONNECTION TO VEHICLE 12VDC BATTERY POWER +

PART MANUFACTURER: Pico
MANUFACTURER PART #: 1905PT

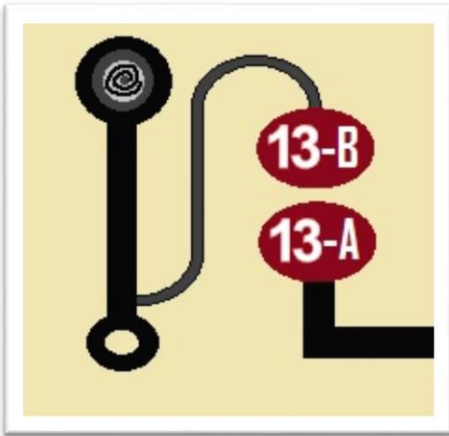This ring terminal is mounted securely to the positive battery post.

12B: DFCM SYSTEM CONNECTION TO VEHICLE 12VDC BATTERY POWER –

PART MANUFACTURER: Pico
MANUFACTURER PART #: 1905PT

This ring terminal is mounted securely to the negative battery post.

13: CNG FRONT BUMPER FUELING DETECTION MEASUREMENT

13-A: CNG FRONT BUMPER FUELING DETETECTION SENSOR - DFCM HARNESS CONNECTOR

PART MANUFACTURER: Delphi
MANUFACTURER PART #: 12015791
CONNECTOR PINOUT:
      A: Bumper Fueling Detection Sensor Signal

13-B: CNG FRONT BUMPER FUELING DETETECTION SENSOR
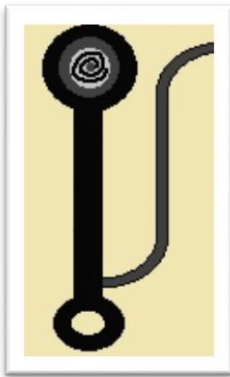
PART MANUFACTURER: WEH
MANUFACTURER PART #: TS55
CONNECTOR PINOUT:
        A: Bumper Fueling Detection Sensor Signal

This sensor allows the DFCM to know if the front bumper CNG tank fill receptacle is being used and the DFCM will prevent the engine starter motor from cranking if it detects that the fill receptacle cap is removed.

14: CNG FUEL STORAGE/SUPPLY SYSTEM BULKHEAD HARNESS JUNCTION
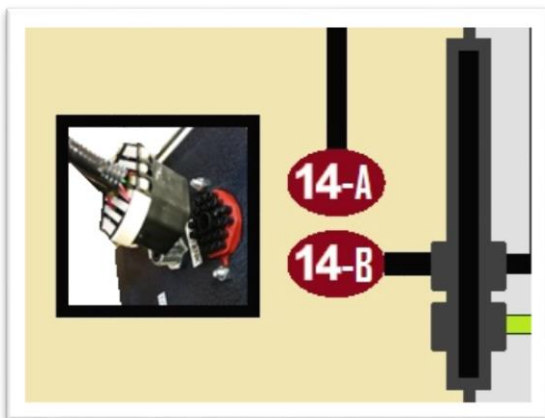
14-A: CNG FUEL STORAGE/SUPPLY SYSTEM HARNESS JUNCTION- DFCM HARNESS CONNECTOR
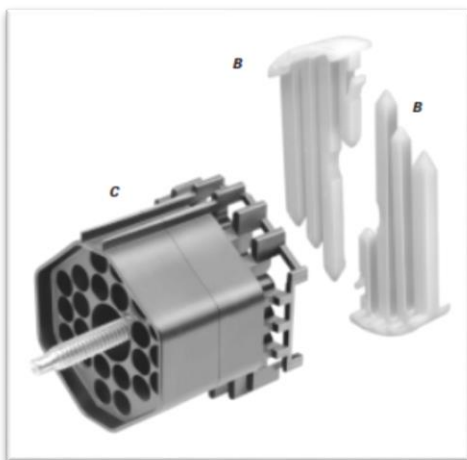
PART MANUFACTURER: Delphi
MANUFACTURER PART #: 15492521
CONNECTOR PINOUT:

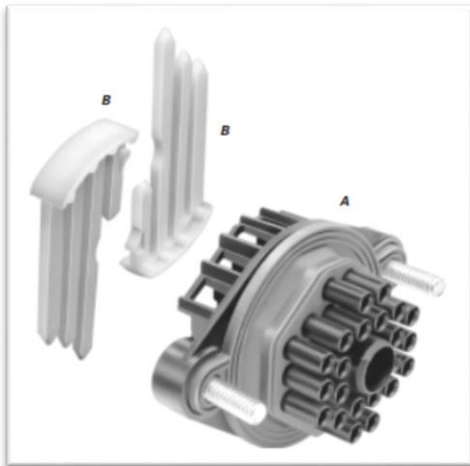|	
A: DRVP (12VDC +)	L: N/A
B: N/A	M: N/A
C: N/A	N: N/A
D: N/A	O: N/A
E: N/A	P: N/A
F: N/A	Q: Proximity Sensor Signal
G: N/A	R: Chassis Ground (12VDC -)
H: CNG Tank Temp. Sensor Signal	S: N/A
I: XDRP (5VDC +)	T: N/A
J: XDRG (5VDC -)	U: N/A
K: CNG Tank Press. Sensor Signal	V: N/A

14-B: CNG FUEL STORAGE/SUPPLY SYSTEM HARNESS JUNCTION - ENCLOSURE BULKHEAD CONNECTOR

PART MANUFACTURER: Delphi
MANUFACTURER PART #: 15492531
CONNECTOR PINOUT:

A: DRVP (12VDC +)	L: N/A
B: N/A	M: N/A
C: N/A	N: N/A
D: N/A	O: N/A
E: N/A	P: N/A
F: N/A	Q: Proximity Sensor Signal
G: N/A	R: Chassis Ground (12VDC -)
H: CNG Tank Temp. Sensor Signal	S: N/A
I: XDRP (5VDC +)	T: N/A
J: XDRG (5VDC -)	U: N/A
K: CNG Tank Press. Sensor Signal	V: N/A

15: CNG FUEL SUPPLY SYSTEM PRESSURE REGULATOR FUEL LOCK OFF SOLENOID VALVE
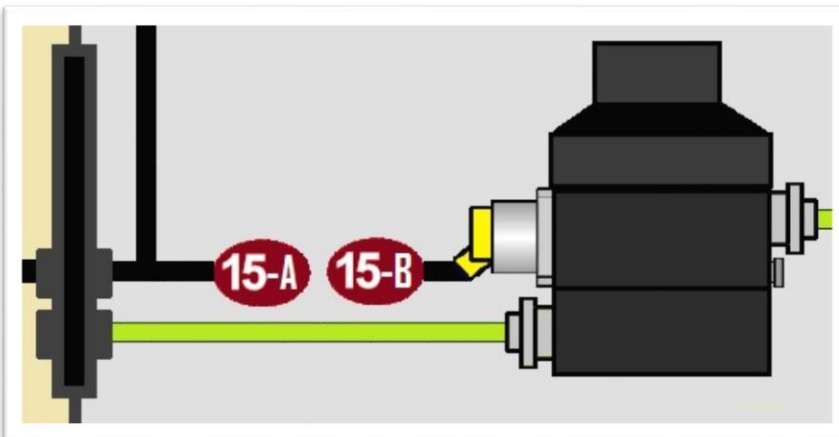
15-A: CNG FUEL RAIL PRESSURE REGULATOR - SOLENOID VALVE HARNESS CONNECTOR
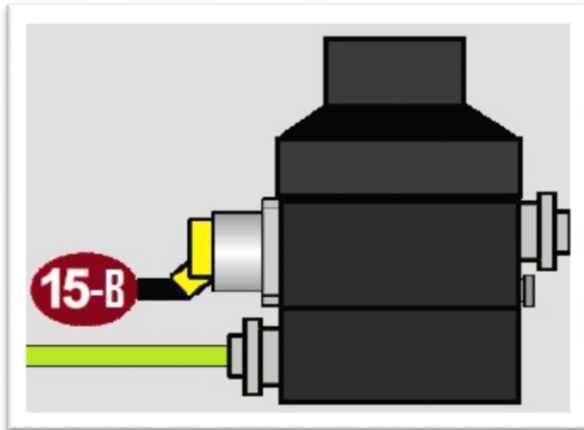
PART MANUFACTURER: Tyco
MANUFACTURER PART #: 282080-1
CONNECTOR PINOUT:
    A: DRVP (12VDC +)
    B: Chassis Ground (12VDC -)

15-B: CNG FUEL RAIL PRESSURE REGULATOR - SOLENOID VALVE

PART MANUFACTURER: ITT Conoflow
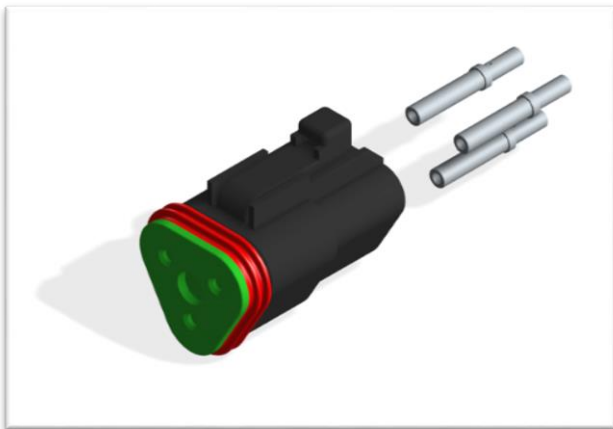MANUFACTURER PART #: O4
CONNECTOR PINOUT:
      A: DRVP (12VDC +)
      B: Chassis Ground (12VDC -)

16: CNG FUEL STORAGE/SUPPLY SYSTEM ENCLOSURE DOOR PROXIMITY MEASUREMENT

16-A: ENCLOSURE DOOR PROXIMITY SENSOR- HARNESS CONNECTOR

CONNECTOR PART MANUFACTURER: Deutsch (Tyco)
CONNECTOR MANUFACTURER PART #: DTO4-3P
CONNECTOR PINOUT:
      A: DRVP (12VDC +)
      B: Chassis Ground (12VDC -)
      C: Proximity Sensor Switched Output (12VDC +)

16-B: ENCLOSURE DOOR PROXIMITY SENSOR

PART MANUFACTURER: Turk
MANUFACTURER PART #: Bi15-M30-VN4X
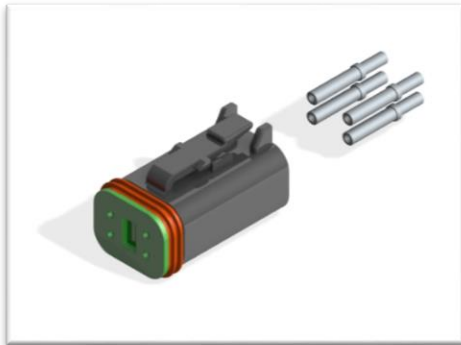CONNECTOR PINOUT:
      A: DRVP (12VDC +)
      B: Chassis Ground (12VDC -)
      C: Proximity Sensor Switched Output (12VDC +)

This is an NPN inductive proximity sensor that senses if the CNG fuel system door is open or closed and the DFCM will prevent the engine starter motor from cranking if the sensor does not detect that the CNG fuel system door is in the closed position.

17: CNG FUEL TANK STORAGE PRESSURE/TEMPERATURE MEASUREMENT

### 17-A: CNG FUEL TANK STORAGE PRESSURE/TEMPERATURE SENSOR - HARNESS CONNECTOR

PART MANUFACTURER: Deutsch (Tyco)
MANUFACTURER PART #: DT04-4P
CONNECTOR PINOUT:
  1: XDRG (5VDC -)
  2: XDRP (5VDC+)
  3: CNG Tank Temp. Signal
  4: CNG Tank Press. Signal

17-B: CNG FUEL TANK STORAGE PRESSURE/TEMPERATURE SENSOR

PART MANUFACTURER: GEMS
MANUFACTURER PART #: 3201T50CPS1J8R00
CONNECTOR PINOUT:
  1: XDRG (5VDC -)
  2: XDRP (5VDC+)
  3: CNG Tank Temp. Signal
  4: CNG Tank Press. Signal

## 18: OEM - DETROIT DIESEL ECM (ENGINE CONTROL MODULE)
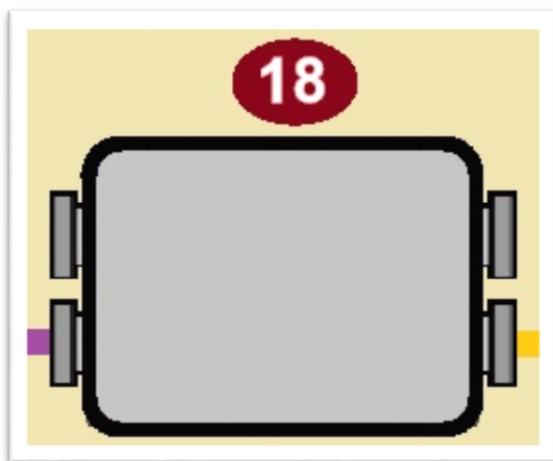
Part Manufacture: Detroit Diesel
Manufacture Part #: DDEC II – DDEC VI

The DFCM uses the J1939 CAN BUS data messages to determine what the Detroit Diesel ECU is doing and what its sensor values are so that it can use these values to determine what part of the base diesel fueling and air charge maps it is operating within, at any given time. The DFCM also sends TSC1 torque limit command messages to this ECU to allow for diesel substitution with the DFCM controlled CNG injection into the charged air intake. The specific parameter that the DFCM monitors on the J1939 CAN BUS are listed on the following page.

Detroit Diesel OEM J1939 CAN BUS Sensors:

18-A: OEM DDEC ACCELERATOR PEDAL SENSOR/DRIVERS DEMANDED TORQUE REQUEST
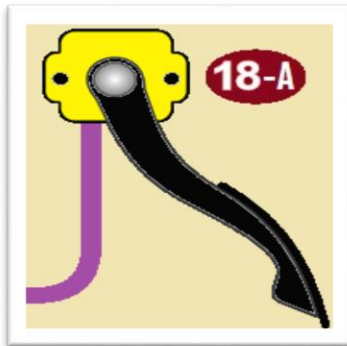
Part Manufacture: Detroit Diesel
Manufacture Part #: N/A

Drivers Demanded Engine Percent Torque: Parameter engineering units – Percent of max torque. This is referenced in order to map the dual fueling algorithm. Dual fueling mode uses an interpolative fueling map that is based on what percent of max torque the driver is demanding and at what engine speed to determine what TSC1 Torque Limit message the DFCM needs to send to the OEM ECU. It is also referenced to determine what voltage the SCM will send to OEM ECU to adjust total air charge into the combustion chamber.
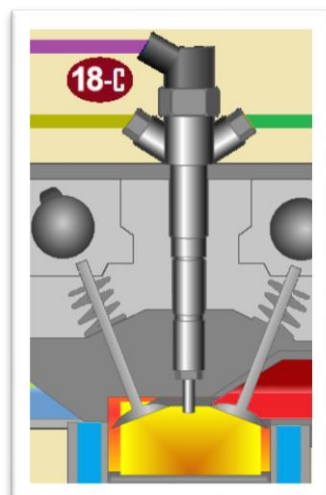
18-B: OEM DDEC ENGINE SPEED SENSOR

Part Manufacture: Detroit Diesel
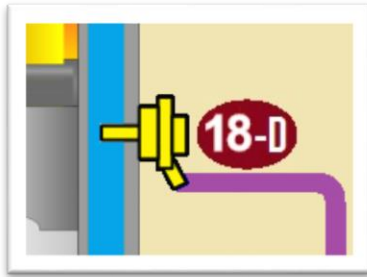Manufacture Part #: N/A

Parameter engineering units – RPM's. This is referenced in order to map the dual fueling algorithm. Dual fueling mode is enabled once the engine exceeds 1000 RPMs, and is disabled once the engine reaches 2000 RPMs.

18-C: OEM DDEC DIESEL FUEL METERING INJECTORS

Part Manufacture: Detroit Diesel
Manufacture Part #: N/A

18-D: OEM DDEC ENGINE COOLANT TEMPRATURE SENSOR (ECT)

Part Manufacture: Detroit Diesel
Manufacture Part #: N/A

Parameter engineering units - Degrees Celsius. When the engine has been running on diesel only fueling mode long enough for the ECT to reach 75 Deg. Celsius, then dual fueling mode can be enabled. This allows for better combustion of the CNG in the combustion chamber.

18-E: OEM DDEC CHECK ENGINE LIGHT

Part Manufacture: Detroit Diesel
Manufacture Part #: N/A

The DFCM monitors the J1939 CAN BUS to see if the Detroit Diesel engine controller is broadcasting any check engine lights, if it is, then the DFCM will disable dual fueling mode until the check engine light is no longer active. This is designed to prevent any damage to the engine while in a fault mode state of operation.

19: ENGINE AFTERTREATMENT SYSTEM
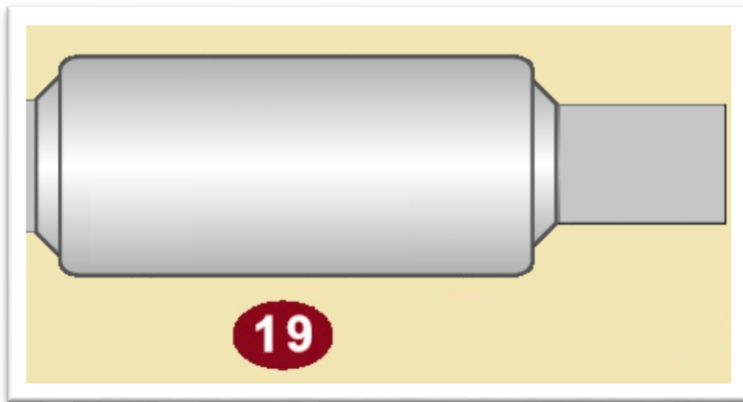
Part Manufacture: Detroit Diesel and or Donaldson
dHybrid Supplied DOC Manufacture Part #: X009472

The engine families that our DD-1000 Dual Fuel system was designed for have a few different aftertreatment configurations and are listed as follows:

Detroit Diesel engines, model years 2002: No aftertreatment.
Detroit Diesel engines, model years 2003-2006: EGR
Detroit Diesel engines, model years 2002: EGR, DOC/DPF

dHybrid Inc. supplies emissions aftertreatment systems for Detroit Diesel Diesel engines, model years 2002 – 2006. The dHybrid supplied emissions aftertreatment system is a Diesel Oxidation Catalyst (DOC) – All vehicle applications that do not have existing emissions equipment in which a dHybrid system is installed on, will be equipped with a DOC to ensure that the stock emissions profile is not compromised while using the DD-1000 Dual Fuel system.

20: DIESEL FUEL SUPPLY/STORAGE SYSTEM – DIESEL TANK
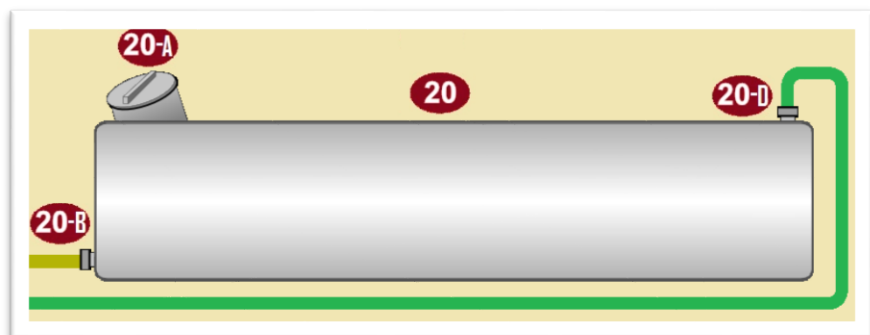
Part Manufacture: Cleveland Tank
Manufacture Part #: CA2250CC-00

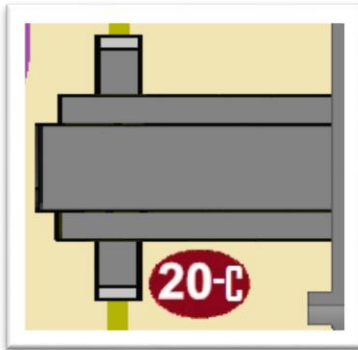### 20-A: DIESEL TANK FILL RECEPTICLE

Part Manufacture: Cleveland Tank
Manufacture Part #: N/A

20-B: DIESEL FUEL SENDING LINE TO ENGINE

Part Manufacture: Freightliner
Manufacture Part #: N/A
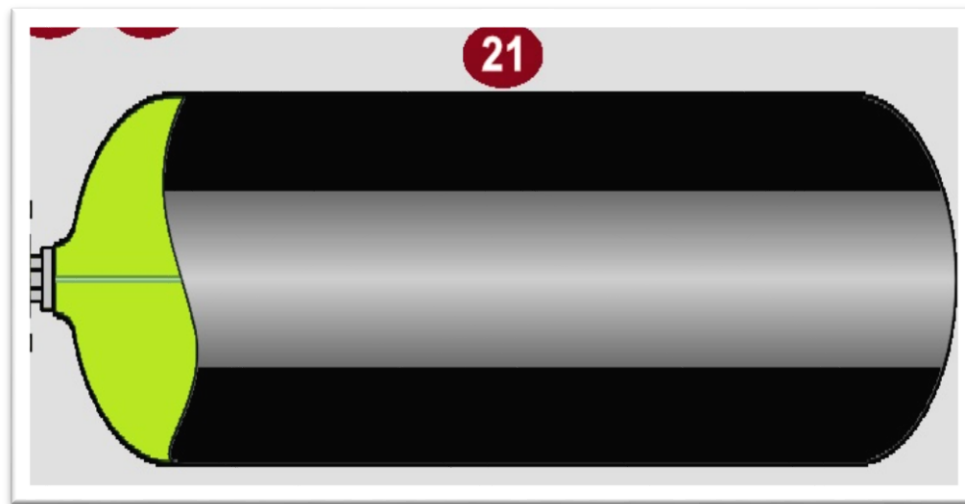
20-C: DIESEL FUEL PUMP

Part Manufacture: Detroit Diesel
Manufacture Part #: N/A

20-D: DIESEL FUEL RETURN LINE FROM ENGINE

Part Manufacture: Freightliner
Manufacture Part #: N/A

21: CNG FUEL STORAGE/SUPPLY SYSTEM- CNG TANK

Part Manufacture: Worthington Ind.
Manufacture Part #: N/A

Natural gas storage – Storage consists of natural gas high-pressure storage cylinders with pressure relief devices, valves, high-pressure lines, CNG tank fuel level sensor, and fill nozzle. All CNG fuel systems are engineered to meet or exceed all safety standards, including NFPA 52, NGV, DOT, FMVSS, SAE, and California Title 13 codes and regulations. These systems are engineered and built by Worthington Industries, the second largest fuel system provider in the country. More can be found on these fuel systems at: www.worthingtonfuelsystems.com
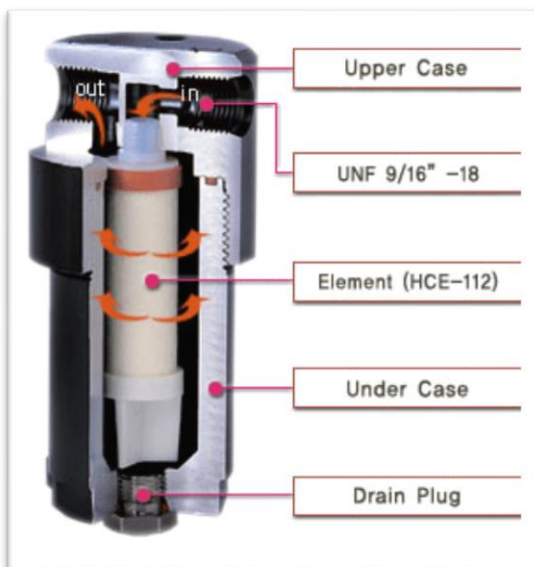
21-A: CNG TANK FILL RECEPTICLE

PART MANUFACTURER: Parker Hannifin
MANUFACTURER PART #: FMS-362H-8MO

21-B: CNG TANK MANUAL LOCK OFF VALVE

PART MANUFACTURER: OMB
MANUFACTURER PART #: BETANEW352

21-C: CNG HIGH PRESSURE FILTER

Upper Case

UNF 9/16" −18

Element (HCE−112)

Under Case

Drain Plug

PART MANUFACTURER: Parker Hannifin
MANUFACTURER PART #: FFC-112 SAE

21-D: CNG PRESSURE REDUCER/REGULATOR

PART MANUFACTURER: ITT Conoflow
MANUFACTURER PART #: HPNGV4

CNG regulator assembly – This is a combination of components that regulate the high-pressure natural gas in the storage system down to a low pressure for the fuel rail. It also includes a coalescing filter to remove oil from the fuel and a quarter turn valve for emergency fuel shutoff.

DD-1000 Dual Fuel System Installation
- All dHybrid Inc. DD-1000 Dual fuel systems components will be installed by dHybrid Inc.
- All CNG fuel storage/supply systems will be installed by dHybrid Inc. or other dHybrid Inc. partner companies.

dHybrid DD-1000 System Outside Useful Life Compliance Labeling

VEHICLE EMISSION CONTROL INFORMATION:
dHybrid Inc. EPA Manufacturer Code: DHY
912 West 1600 South, Suite B-104
St. George, UT 84770
Contact Phone #: 435-862-9544

Conforms to EPA regulations: 40 CFR Parts 85, 86 and 1065 el
US EPA: On Highway MHD – HHD engines OBD: FED, Fuel: CNG, Mixed-Fuel or dual fuel
OBD: N/A, Fuel: N/A
TWC/HO2S/FI NO Adjustments
Conversion Manufacturer Engine Family Name: FDHYH14.0DD1 Evap Family Name: N/A
OEM Engine Family: 2DDXH12.7EGL, 2DDXH14.0ELL, 3DDXH12.7EGY, 3DDXH14.0ELY, 4DDXH12.7EGY, 4DDXH14.0ELY, 5DDXH12.7EGY, 5DDXH14.0ELY, 6DDXH12.7EGY, 6DDXH14.0ELY, 7DDXH12.8DJA, 7DDXH14.0ELY, 8DDXH12.8DJA, 8DDXH12.8DJC, 8DDXH14.0ELY, 8DDXH14.0ELC, 8DDXH12.8TER, 8DDXH14.8EEY, 8DDXH14.8EEC, 9DDXH12.8DJA, 9DDXH12.8FED, 9DDXH12.8TER, 9DDXH14.0ELY, 9DDXH14.8EEY, 9DDXH12.8DJD, 9DDXH12.8FEY, 9DDXH14.0ELD, 9DDXH14.8EED.
EIN:xxxxxxxxxxxxxxxxx; Conversion Date: XX/14 Testing has shown that this clean alternative fuel conversion system meets EPA emission standards under the OUL age vehicle/engine program

dHybrid Inc. DD-1000 Dual Fuel System Warranty:

All dHybrid Inc. components and controls are protected by our Standard Product Warranty. dHybrid Inc. warrants the components and controls of their Dual Fuel products to be free from defects in material for a period of one year from the date of the dHybrid Inc. startup. dHybrid Inc. shall replace or repair, at their option, any product or parts, which after review or examination by a dHybrid Inc. certified installer, are deemed to be defective.

dHybrid Inc. warrants for one year against any damage to the installed engine caused by the failure of dHybrid Inc.'s Dual Fuel Products. dHybrid Inc. is not responsible for any consequential damages. For engines retro-fitted by dHybrid Inc. staff technicians or properly installed by dHybrid Inc. certified installers, dHybrid Inc. will, at its option, repair or replace any engine damaged by the dHybrid Inc. Dual Fuel system after having an opportunity to inspect the engine as it is dismantled. If necessary, cause of damage may be determined by a mutually accepted neutral third party. This warranty shall be void if dHybrid Inc. components have been altered by unauthorized agents or modified in any manner from the original installation configurations.

dHybrid Inc. warrants that for engines in good working order, Dual Fuel shall operate within all engine manufacturers' specifications.

dHybrid Inc. does not warrant efficient Dual Fuel engine performance if: a) after the date of the initial installation and startup, an engine receives service maintenance which changes the engine's operating and/or load specifications from initial startup; b) the Dual Fuel product was installed on an engine that was not pre-qualified to be in good working order; or c) the Dual Fuel product was installed on an engine that has not received EPA approval through dHybrid Inc.

dHybrid Inc. specifically makes no warranty with respect to accidental or deliberate damage resulting from: improper installation; installation by noncertified technicians; engine misuse; lack of activation; deletion or alteration of OEM alarm codes for OE engine safety protection; lack of normal access to the OEM CAN-BUS communication network; abuse; improper maintenance; fuel contamination; acts of God; vandalism and any and all conditions not related to the dHybrid Inc. dual fuel system.

This warranty is expressly in lieu of all other warranties, expressed or implied, including warranties of merchantability and fitness for a particular purpose.

dHybrid Inc. Dealers supplying the Dual Fuel products will give, for the benefit of their customers, a warranty no less favorable to their customers than the limited warranty given to the dealer by dHybrid Inc.

 dHybrid Inc. Duel Fuel technology does not change the base diesel engine design and warranties the Dual Fuel System components for one year after installation. Industry documentation and regulations cite the following in regard to the effects of an approved aftermarket technology on OEM warranties:

Magnusson-Moss Warranty Act of 1975 says the consumer has the freedom to choose aftermarket parts and upgrades without having the OEM warranty voided.

The Federal Trade Commission (FTC) issued a Consumer Alert in January 2011 confirming that it is in fact illegal to void warranties or deny coverage for the use of an aftermarket part.

Specifically, the EPA Alternate Fuel Conversions final rule published on April 8, 2011 states,"the clean alternative fuel conversion manufacturer would normally be held accountable for fixing problems that occur as the result of conversion" but "the OEM would generally retain any parts or systems that retain their original function following conversion and areunaffected by the conversion."

Best regards,

Morgan Mackelprang
dHybrid Inc.